HIGH ALTITUDE OBSERVATORY

Boulder, Colorado

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Subject: Status Report No. 8 for NASA Grant NsG-136-61

Gentlemen:

This letter constitutes Status Report No. 8 under NASA Grant NsG-136-61 for the period 1 July 1965 through 31 December 1965. Studies of Jupiter continued and some solar reductions were carried out.

In collaboration with Ted Hartz of the Canadian Defense Research Telecommunications Establishment, Warwick was able to establish the consistent identification of solar Type III (fast drift) radio bursts down to 1.2 Mc. The low-frequency data came from the Canadian "topside sounder," Alouette, and were contemporary with Type IIIs observed in Boulder from 20 to 41 Mc. They studied the persistence of the emission as a function of frequency, and established that it is reasonable to interpret the decay of the emission in terms of the environmental coronal electron temperature. Since the radio frequency of the burst represents the electron density, in effect we have a means for establishing coronal temperatures at extremely high elevations, as much as 10 R from the sun, and clearly in the regions of space occupied by coronal streamers.

These data support the contention that the Type III phenomenon is essentially a low-frequency effect, and suggest that a search be made for the bursts down to the lowest frequencies (about 100 kc) nominally expected to penetrate the interplanetary plasma. These data are also consistent in a general way with the coronal model devised by Chapman from Blackwell's South American data on the white-light corona.

One consequence of this interpretation of Type III burst persistence as a temperature effect (e.g., long durations imply high temperatures) is that the "continuum" observed to follow Type IIIs (called TypeV) may itself be generated in extremely hot coronal regions created in the wake of strong or repeated Type III bursts. A subsequent stream of fast particles, similar to those producing ordinary Type IIIs, excites a corona superheated by the earlier particles; the emission that results endures for a minute or two instead of decaying within a few seconds (at 20 or 30 Mc). A detailed study of Type V records reveals many bursts that are consistent with this hypothesis.

The corona may normally receive its energy from other processes than this fast particle heating mechanism; the superheated corona following a Type III particle stream cools within ten minutes back to the preburst condition. However, at times of decametric continuum Type IIIs occur so frequently that we suggest they are then likely to be a major source of corona heating in active centers.

The nature of decametric radio emission from Jupiter and the known properties of its magnetic field suggest that trapped, energetic (10-kev) electrons frequently impinge on its upper atmosphere. These events, occurring at the time of decametric emission, could ionize atmospheric constituents and cause a visible recombination spectrum. This Jupiter auroral emission has long been suspected but never observed. Past attempts to observe the effect in H- have largely used filter monochromators, with bandpass 15 to 20 A, or low dispersion spectrographs. These early efforts were in the form of patrols, as the time and place of suspected emission was not known, and the best previous search was limited to auroras brighter than 100 kilorayleighs, none of which were observed.

The recent finding that Jupiter's satellite Io controls much of the radio emission makes it possible to predict the time and locus of probable auroras on Jupiter and thus greatly increases the chance of detection. Auroral activity is likely to occur on magnetic field lines connecting Io to Jupiter, at times and places favorable for detection several times per week, with duration of 3 to 5 hr per event. Eddy and George Dulk, of the University of Colorado, who did much of the work on the Io correlation, have re-initiated the optical search for these events. In August they were allowed to use the photoelectric scanner on the large coronagraph-spectrograph at Sacramento Peak Observatory. In November and December they continued the search with higher resolution using the Coude spectrograph at the 84-in. telescope at the Kitt Peak National Observatory. Auroral emission expected is a narrow, weak perturbation or asymmetry in certain of the reflected solar absorption lines, doppler-shifted from line center by planetary rotation. With spectral resolution of about 0.1 A and dispersion 4 A/mm a 1.2 kilorayleigh aurora should be detectable in H- , and approximately 10 kilorayleigh auroras elsewhere in the spectrum. Early analysis of the plates made at Kitt Peak shows no evidence of these effects.